PREFACE AND ACKNOWLEDGMENTS

This report deals with development of guidelines for plant operators seeking modern and efficient egg grading and packing plant layouts, along with building specifications and design drawings for the physical plant.

The research was conducted by the Handling and Facilities Research Branch, Transportation and Facilities Research Division, Agricultural Research Service, in cooperation with the University of California Department of Food Sciences and Technology at Davis, Calif. Assistance in developing structural designs, building specifications, and working drawings was furnished by Dr. E. D. Rodda, formerly with the Department of Agricultural Engineering, University of California, Davis, Calif.

Appreciation is expressed to the packing materials firms that furnished the data on dimensions and weight for packing materials, and to the management of commercial egg grading and packing plants that cooperated by making their facilities available for study.

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SHELL EGG PROCESSING PLANT DESIGN

By John A. Hamann, Roger E. Walters, Errol D. Rodda, Gordon Serpa, and Edward W. Spangler [1]

SUMMARY

Materials-handling systems and associated equipment are suggested, for various production rates, for egg grading and packing plants that handle a volume ranging from 1,000 to 5,000 cases per week. Nomograms designed to determine exact storage space requirements for various inventory situations are illustrated, and their use, under a specific situation, is discussed. Equipment layouts for the processing area, involving equipment designed for specified production rates, are illustrated with appropriate flow lines for product and materials. Placement of areas auxiliary to the processing and storage areas to provide for economic operation, space utilization, plant construction, and expandability are explained and illustrated. Construction detail of an example design is illustrated by detailed plan drawings that are explained.

INTRODUCTION

The trend toward grading and packing eggs from large commercial flocks at the point of production, instead of in large-volume plants at country shipping points or in terminal markets, has brought about the need for many changes in the operating techniques of the commercial egg grading and packing plant. Much of the equipment and many of the operating methods have become outdated. Consequently, operators are seeking answers to questions on improving the building design and plant layout, and use of modern, efficient materials-handling methods. In addition, the strict sanitary regulations today frequently require costly building modification.

A study of West Coast plants indicated: (1) A need for more precise planning procedures; (2) a general lack of understanding of the engineering principles that can be employed in planning and designing a processing plant; and (3) a lack of knowledge of the operating alternatives that are available to the processor in a new installation. Many of the planning techniques that are available and used widely by other industries have not been used by egg handlers in modernizing their operations, perhaps because they may not be aware of them.

Many plant operators have done a commendable job of increasing their overall plant efficiency. This efficiency can be attributed to their ingenuity; to the development, by manufacturers, of new equipment; and to the development of improved work methods through Department research (*5, 7, 8, 9, 10, 11, 23, 24, 25*).[2]

Since there are many operating variables and almost as many operating procedures as plants, this report has developed guidelines for planners and operators to use in selecting the most effective space and equipment combinations suitable for their particular situations. Plants studied included both those that packed all their product under one brand label and those that packed their product under many brand labels. Production levels studied ranged from the comparatively low level of the small on-the-farm plant that handled the output from a single flock only, to the much higher level of the large packing plant that handled the output from several large flocks.

In developing sound planning procedures, such common factors as equipment (cost and size), plant site (size and configuration), and plant structure (size and style) have been considered from the standpoint of their interaction on seldom

[1] John A. Hamann, Edward W. Spangler, and Roger E. Walters, Handling and Facilities Research Branch, Agricultural Research Service. Mr. Walters has resigned. Errol D. Rodda and Gordon Serpa, formerly staff members at the University of California, Davis, Calif.

[2] Italic numbers in parentheses refer to items in Literature Cited, p. 30.

considered variables. Examples of such variables are: Plant location (in relation to production and marketing areas), varying numbers of carton brands to be packed, proximity of carton suppliers, volume of shipments and receipts, and future expansion.

Since most egg processing plants have either expanded or are planning to expand, major emphasis in this report was placed on expansion potentials that would permit structural changes without requiring a shutdown of operation and that would not cause operational inefficiency after the plant is expanded. Emphasis was also placed on food processing plant design, rather than on farm building or warehouse design. Special consideration was given to structural features that are required for food plant sanitation.

Other items that were given special consideration included flexibility in operating schedules, efficient utilization of space, and ready accessibility to areas subject to heavy traffic.

In conducting this research, engineers who were familiar with processing plant layout and operating problems, as well as structural design problems, teamed up with food technologists who were familiar with problems connected with the processing and storage of poultry products. This report develops and applies engineering information to guide the plant operator in solving these marketing problems.[3]

PROCEDURE

Forty-six egg grading and packing plants in California were visited to observe operating problems and to discuss these problems with the management. Measurements were made in the plants to verify or adjust theoretical space requirements for various plant functions. Materials handling, materials storage, product processing, and product storage were considered separately, and then jointly, in terms of overall arrangement, expansion potential, and structural requirements. Information on such factors as package dimensions and weight, quantity purchase rates, and delivery schedules was obtained from manufacturers of containers. Building construction firms were consulted regarding building materials. The capacities, dimensions, and costs of equipment were made available through factory representatives.

To visualize space and equipment arrangement, plastic templates of the equipment, cut to scale, were positioned on scaled paper on a layout board. Thus items of equipment could be shifted from time to time as work proceeded. This layout planning technique has been used effectively for years in developing efficient layouts for large factories. Although the egg grading and packing plant is not as large as facilities in heavy industries and the operations are not as complex, this technique can be applied just as effectively in planning the layout for egg grading and packing operations. It can also be just as valuable to these operators in avoiding costly changes in design after construction is started or completed.

MATERIALS-HANDLING SYSTEMS

The objective of a materials-handling system is to use a minimum of time, labor, equipment, and space to handle materials as they pass through the various plant operations, and in an egg grading and packing plant, to minimize hazards to product quality. "Handling" includes unloading and loading and all movement of materials within the plant.

Before detailed plans are made for the plant structure, the type of materials-handling system to be used should be determined so that its effect on overall design can be taken into account. Selection of equipment for the system is influenced by the type of loading docks, the aisle widths, the amount of storage area required, the floor load limits, and the ceiling heights.

Production level, source of eggs, and sales methods are important in the selection of the handling system. It should not be selected on the basis of existing production level alone; future expansion plans should be a major consideration because of the influence that building dimensions have on an efficient operation.

Many of the egg grading and packing operations studied showed that good judgment had been

[3] Working drawings (Plan No. 6095—Egg Processing Plant) may be obtained from the extension agricultural engineer at your State university, or you may wish to send your request to Agricultural Engineer, Federal Extension Service, U.S. Department of Agriculture, Washington, D.C. 20250, who will forward the request for you. There may be a small charge to cover cost of printing.

used in selecting handling equipment that reduced labor requirements and minimized hazards to product quality. Careful consideration of combinations and alternatives available was paying dividends.

The equipment to be considered for handling eggs and packing materials in the egg processing plant is standard, for the most part, and requires no special adaptations. However, by confining the equipment to its specific functions, and by considering its limitations, guidelines were developed for wise selection and use.

Materials-Handling Equipment

Materials-handling equipment for egg grading and packing plants can be divided into two broad categories: (1) Mobile equipment, such as a handtruck, which is designed to move with the item being transported; and (2) fixed equipment, such as a roller or belt conveyor, which is in a fixed position, but is designed to move items placed upon it.

Transport by Truck

When trucks are used to move materials or products within the plant, several product units are generally moved at one time. The most commonly used trucks are two-wheel handtrucks. The stevedore type (fig. 1*A*) and the clamp type (fig. 1*B*) are designed for moving small loads of one to four cases of eggs over short distances. The jack and semilive skid (fig. 1*C*), the platform truck and dead skid (fig. 1*D*), and the pallet transporter (fig. 1*E*), all of which are operated manually, are used for moving larger loads (15 to 30 cases) over short distances. The walk-type electric pallet transporter (fig. 1*F*); the forklift truck (fig. 1*G*); and the straddle-type forklift truck (fig. 1*H*), with its specially designed pallet (fig. 1*I*), move large loads both short and long distances, but have automotive power added.

The two-wheel handtrucks are common in almost every size of operation. The jack and semilive skid and the manual hydraulic low-lift platform truck using the dead skid were found in many small operations. This type of equipment, which uses the skid, is being replaced by the pallet transporter, however, to gain the flexibility advantages of a palletized operation.

The manual pallet transporter lends itself to both the large and the small operation. In the large operation, it is an ideal item of auxiliary equipment for short moves. Although it is more expensive than the semilive skid and jack, pallets used with it cost much less than the semilive skids used with the jack. Further, pallets can be used with the forklift truck if operations are expanded.

When long moves or changes in elevation during a move are encountered, the walk-type electric pallet transporter often replaces the manual pallet transporter. A 2,000-pound-capacity unit is adequate for egg packing operations.

Forklift trucks come in various sizes and styles; they are powered by gasoline, butane, or electricity. As in the transporter, the 2,000-pound-capacity forklift is adequate for handling operations inside the egg processing plant. The stand-up-rider type is recommended over the sitting-rider type because of intermittent use and the frequency with which the operator is required to dismount during normal use. The stand-up-rider type is not only easier to mount, but also requires less aisle space for turning and stacking.

Although many plants operate with gasoline-powered trucks, this type of equipment has several disadvantages. One disadvantage is that gasoline engines require warmup time for efficient operation. Since forklift trucks are not in continuous use in egg packing plants, fuel and driver time are frequently wasted in warming up the engines. Another disadvantage is that, unless they are carefully maintained and outfitted with the proper type of muffler systems, they produce fumes that are often objectionable and may be dangerous to plant personnel. Electric-powered trucks, on the other hand, do not have these shortcomings.

The straddle-type forklift truck (fig. 1*H*) is suitable for use in facilities with narrow aisles. It is designed with outriggers to support the frontal load and uses a wing-type pallet.

In selecting a forklift truck, the following factors should be considered. (1) Its limitations in stacking height should fit the planned stack height. (2) It should have a turning radius that will allow it to turn in the narrowest aisle width. (3) It should be fitted with solid tires that are suited for use in new buildings with smooth floors. If the forklift is to be used in old buildings with rough or badly worn floors, it should be fitted with pneumatic tires.

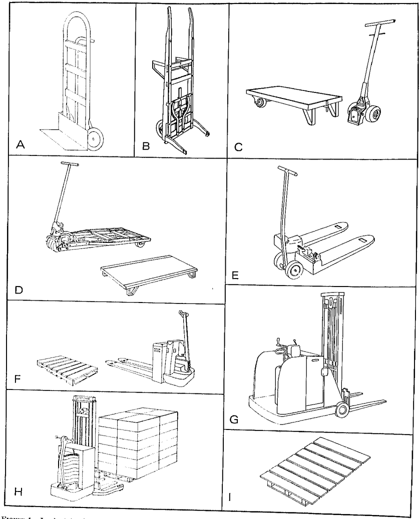


FIGURE 1.—In-plant truck transport equipment: *A*, Stevedore-type handtruck; *B*, clamp-type handtruck; *C*, jack and semilive skid; *D*, platform and dead skid; *E*, pallet transporter; *F*, walk-type electric pallet transporter; *G*, forklift truck; *H*, straddle-type forklift truck; *I*, wing-type pallet for straddle-type forklift truck.

During the study, a production level was determined at which the forklift type of equipment was preferred over handtrucks and manually powered transporters, or when they were supplemented by power-type forklift trucks equipped for high stacking. Handling receipts and shipments in small lots encourages the use of handtrucks, whereas handling in large lots (truckload size) justifies an investment in forklift trucks.

A comparison of labor requirements for moving materials by handtruck versus forklift truck (fig. 2) shows that the labor required for the forklift truck is 50 percent less than that required by the handtruck, even when distances of less than 40 feet are involved. In addition, use of the handtruck causes more loading, unloading, and wait time for drivers of highway transport trucks.

Transport by Conveyor

Materials-handling equipment that provides continuous movement is confined to powered or gravity conveyors. Often they are used to move eggs to various points in the plant where space

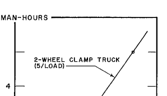


FIGURE 2.—Labor required to transport 1,000 containers, by type of truck and size of load.

does not permit movement by truck or where the movement of single case quantities is required intermittently. Examples are at the grading line loading station (to provide a working stock of eggs for the loader), and at the casing off end of the operation where accumulations of graded and packed eggs await palletizing. Some plants also use conveyors to move eggs from the refrigerated area to the grading and packing line or to return graded eggs from the line to the cooler or for both operations.

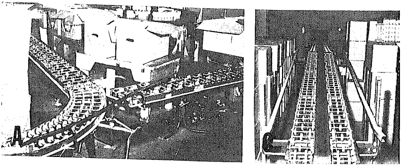
The types of conveyors commonly used in egg packing are skate-wheel gravity conveyor (fig. 3*A*), power-driven belt conveyor (fig. 3*B*), and combinations of the two (fig. 3*C*). Conveyors can be bought in almost any length and with various turning radii. The selection of the proper conveyor might best be left to a representative of a reputable materials-handling equipment company. The skate-wheel conveyor should be considered only for moving containers of eggs on conveyors level with the floor, or on very slight inclines, to avoid breakage that can be caused by the sharp impact that occurs on steep inclines.

The gravity conveyor, when on an incline, allows the buildup of excessive pressure when several cases accumulate on it. Additionally, when it is routed across aisles, it may require that traffic be routed around it or that a conveyor gate (fig. 4) or crossover stairway be provided.

The combination gravity/power conveyor, on the other hand, is designed to override to prevent buildup of excessive pressure, whether the conveyor is on a level run or on an incline. It has an additional advantage over the gravity conveyor in that, by use of inclines, it can be routed over aisles without obstructing the movement of personnel or equipment.

LOADING DOCKS

The loading dock is essential to a materials-handling system since all materials must come into and move away from the processing plant via some sort of loading dock. The dock at the cooler storage end of the processing plant should be at truck-bed elevation. This elevation will allow pallet loads of product to be loaded onto trucks without rehandling. The dock at the dry material storage end of the plant can be at ground level. Packing



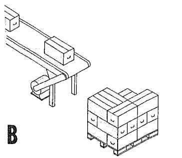


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FIGURE 3.—Types of conveyors generally used in egg grading and packing plants: *A*, Skate-wheel gravity conveyor; *B*, power-driven belt conveyor; *C*, combination gravity/power conveyor.

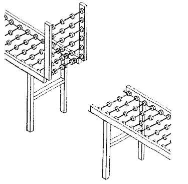

FIGURE 4.—Skate-wheel gravity conveyor with gate.

materials requirements for plants handling from 1,000 to 5,000 cases per week can be readily handled by use of pallet dollies—supplemented, as necessary, by two-wheel handtrucks.

The pallet dolly is used in the absence of a loading dock at the dry material storage end of the processing plant. The dolly is a good investment for any plant operating on a palletized basis. It can be used to carry pallet loads of packing materials to the rear of the truck bed for pickup by a forklift truck operating at ground level (fig. 5). Occasional loads of packing materials that are received in pallet loads, such as corrugated egg cases, can be brought in at the truck-bed-height dock at the cooler storage end of the plant and transported through the cooler and processing room to the dry storage area. The topography of the site may sometimes make it economical to have two docks at truck-bed height.

The dock for incoming and outgoing eggs should be covered and sufficiently wide to accommodate two trucks. Dock space not in use can be used for storage space for empty pallets. The structural design of a loading dock at truck-bed level is provided in the structures section (p. 60).

Two types of dockboards (figs. 6 and 7) are very helpful for an efficient operation. The typical dockboard or bridge plate is a device that bridges a 3- to 4-inch difference in elevation between the truck bed and the loading dock. When this difference exceeds 4 inches, a hinged dockboard must be used. When differences in height exceed 4 inches, forklift truck clearance may be insufficient, even with the use of a hinged dockboard, and an adjustable height dock section may be required.

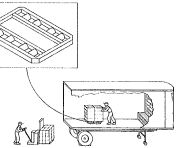

FIGURE 5.—The pallet dolly reduces unloading time when forklight trucks cannot be driven onto delivery truck.

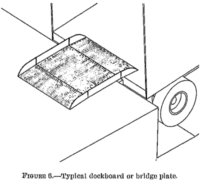

FIGURE 6.—Typical dockboard or bridge plate.

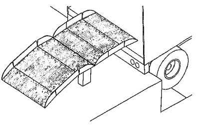

FIGURE 7.—Hinged dockboard or bridge plate.

The adjustable height dock section operates hydraulically and can be raised or lowered to the proper height to accommodate a wide range of truck bed heights. It must be built into the dock structure and is considerably more expensive than the conventional dockboard. However, it should be considered when a number of truck sizes may be encountered.

Since forklift truck drivers employed at small egg grading and packing plants are frequently inexperienced, dockboards or dock sections should have 2- or 3-inch-side rails as a precaution against running the forklift off the side.

STORAGE AREAS

Two types of storage are required in an egg grading and packing plant: cool storage and unrefrigerated or dry storage. The first is used for graded and ungraded eggs; and the second for packing materials, cartons, cases, wire baskets, and miscellaneous items such as cleaning compounds and oil for treating shell eggs.

Most dry storage areas have the materials stacked to the ceiling. In cool storage, pallet racks are required to take advantage of high stacking and to minimize egg breakage (figs. 8 and 9). The use of pallet racks becomes even more important when only partly filled pallets are involved (fig. 10).

Some of the factors critical to the facility design are those that involve the building dimensions and floor construction. In determining the most desirable heights for ceiling and construction requirements for floors for a plant with a production

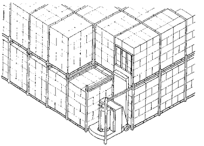

FIGURE 8.—Pallet racks permit utilization of egg cooler air rights without crushing hazards of high stacking.

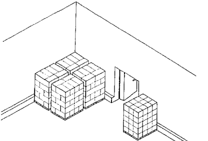

FIGURE 9.—Cooler space is lost when high stacking is not used in egg cooler.

range of 1,000 to 5,000 cases per week, specific pallet stacking patterns had to be established for the associated package dimensions and the weights of the loads involved.

For this size of operation, the ceiling should be 14 feet high. This height is based on stacking patterns and on quantitative and dimensional data [4] shown in appendix figures 48 to 63. The 14-foot ceiling provides adequate clearance for moving products or materials, or both, in or out of position at high-stack levels, permits sufficient space for the circulation of air necessary in the cooler, and minimizes compression damage to cartons and filler flats in dry storage.

[4] The pallet size and stacking patterns selected are those most commonly used in the industry.

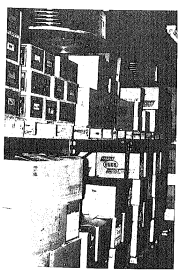

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FIGURE 10.—Pallet racks for less than full pallet loads conserve cooler space.

Good storage practices involve rotating stock, easy accessibility to all items stored, a systematic method for locating items, and positioning items so that those most frequently used are closest to the point of use. Also, lots or items should not be mixed. Using a center aisle, with items stacked four or five pallets deep on each side, causes difficulty in the storage of small lots of supplies that are used infrequently. A solution to this problem would be to use one or more branch aisles off the main aisle. This system was used most often in coolers where it was necessary to make up small lots of graded eggs. It can work equally well in dry storage areas.

Unrefrigerated Storage

Accurate planning for unrefrigerated (dry) storage space is difficult, largely because of the variety of outlets that can be supplied. Each new account involves a change in the packing mate-

rials inventory. Three general categories of situations are considered.[5]

The first situation involves the plant that packs for a single large account that warehouses its own packing materials. Generally the firm keeps large quantities of these materials on hand, supplying the packing plant on a daily, weekly, or backhaul basis. This type of storage is really "in-transit" storage, and generally presents no problem because packing materials are available daily if necessary.

The second situation is the plant that packs for one large outlet but receives packing materials direct from the manufacturer. The plant may receive a full truckload or carload lot of materials. If the load is to be divided between two or more plants supplying the same outlet, the plant may then receive only part of the load. When more than one plant in the same area packs for the same customer, the plants often cooperate by making their supplies of packing materials available to each other in emergencies.

The third situation is the plant that packs for several accounts and maintains an inventory of packing materials carrying different brand names. This situation requires a large inventory and a great deal of warehouse planning.

Determination of Unrefrigerated Storage Space Requirements

The rate of use of packing materials and the time between order placement and delivery affect storage space needs considerably. Minimum delivery time for the various items ranged from about 1 week to 1 month from the time the order was placed. Other factors influencing storage space needs are discounts received for quantity purchases, allowable investment in inventory, distance from the supplier, weather conditions at the shipping or receiving time, and the reliability of the supplier.

If the plant operator assumes that he must maintain a week's reserve supply of packing materials because he may be short by this amount at the time of delivery, he must also assume that he may be overstocked by the same amount at the time of delivery because of errors in estimating. To provide sufficient dry storage space, then, sufficient space should be available for a standby supply, some of which can be expected to be on hand when the next order is received.

To place purchase orders for packing materials wisely, the plant operator must be able to predict, in advance, not only the volume of his receipts and the output of his graded product during a particular period, but also the time lag that will occur between order placement and delivery. The accuracy of these predictions can provide substantial savings over the years. Inventory costs are dependent on the cost of maintaining storage space, the amount of capital tied up in the materials inventory, and the amount of property tax or other taxes levied on the building. No specific approach can be followed that will fit all situations, because circumstances for each plant are different.

To assist the plant operator in making valid estimates a series of nomographs (figs. 11–19) (*14*) were developed for determining accurately the space required to store each item of packing material. The projections by nomograph are only applicable when the stack patterns and heights specified in appendix figures 53 through 64 are used. They can be adapted to other situations only if adjustments in arrangements and corresponding values are made. These projections establish space required for the particular item without regard to accessibility or partly filled bays or aisles.

Figure 11 is a nomograph for determining space requirements and the number of molded pulp cartons (2 by 6) and pallets needed for a range of production rates. Using this nomograph, the square feet of floorspace and number of pallets required can be determined from scales 4 and 5 when any two of the values on scales 1, 2, or 3 are known; that is, production rate, use time in weeks, and bundles of cartons.

[5] A fourth situation that is developing involves an operation in which polystyrene or similar material is shaped into cartons and printed where used. However, the present cost of this material and fabricating equipment and the sensitivity of the equipment and material to changes in temperature during the manufacturing process have tended to limit its use. Therefore, the necessary facility for such an operation was not considered in this report. If it becomes feasible to manufacture packing materials in the plant, the warehouse space required for storing an inventory of packing materials will be reduced. A great deal of additional warehouse space will be required for the fabrication operation.

The following describes the procedure that would be followed by a firm packing 2,000 cases per week to determine the number of 2 by 6 molded pulp cartons, the number of pallets, and the stacking area required (pallets stacked two high). On figure 11, place a straightedge so that it rests on 2,000 cases on scale 1 and on 1 week on scale 2. Mark the point where an extension of this line (shown by broken line) intersects the number of bundles of cartons (scale 3) and the floorspace required (scale 4). Read directly across from this point to the number of pallets required (scale 5). The readings on the scales will show that 240 bundles of molded pulp cartons are needed to pack 2,000 cases of eggs, and that these cartons will require 135 square feet of floorspace and 15.6 pallets. The values for the required floorspace (scale 4) and for the required number of pallets (scale 5) should be estimated in increments of one pallet; that is, a partly filled pallet requires as much floorspace as a fully loaded one, or as much as two full pallets stacked one on top the other.

The space needed for any other item requiring dry storage in an egg grading and packing operation can be determined similarly by using the nomographs in figures 12 through 19. Adjustment factors have been added to two of the nomographs (figs. 11 and 14) to provide for the additional space occupied by such outsized items as bundles of pillow-post cartons and 4 by 5 filler flats.

In using this inventory control and required space prediction system, the total access and main aisle space that is required for each inventory situation must be considered. Frequently storage space is determined under the assumption that the entire space, except for the 8-foot main aisle through the area, is available for storage. This is seldom true because of constantly changing levels of inventory rates of use for stored items. To show the effect that access aisles have on total storage space requirements, an example of an actual inventory situation is illustrated in figure 20.

To determine the aisle factor for any particular storage situation a scale model layout with pallet templates should be set up, as in figure 20, using the dimensions (plus use factor) given in appendix figures 48 through 63. Then, using the ratio of the total storage area to the actually used area, the aisle factor is determined by simple proportion. The value of the unknown (aisle factor) in figure 20 is solved as follows:

$$1{,}804:1=2{,}525:X$$
$$1{,}804X=2{,}525$$
$$X=1.4$$
$$1.4=\text{aisle factor}$$

The aisle space and pallet position shown is necessary to maintain accessibility to all the stored items in the inventory mixture illustrated. To arrive at the total storage space, then, the actual space occupied by stacks of pallets (using the pallet space values in figures 48 to 63) must be multiplied by 1.4.

Cold Storage

Coolers should be designed to hold the storage temperature between 50° and 60° F. at all times and to maintain a relative humidity of 75 to 80 percent. Good management practice, however, requires that the temperature and humidity of the cooler be carefully adjusted from time to time as the temperature and humidity of the grading room fluctuate to avoid moisture condensation (sweating) on the egg shell. Sweating occurs when the storage and working area atmospheric conditions are not in balance. It hastens the loss of egg quality, makes eggs more difficult to handle, and increases the possibility of bacterial contamination. Johndrew and Baker (*13*) developed a guide for determining critical humidity-temperature relationships (table 1).

TABLE 1.—*Relationship between cooler temperatures and temperatures and humidity of grading room*

Temperature of grading room (F.)	Minimum relative humidity in grading room that will not cause sweating if egg temperature is—		
	55° F.	60° F.	65° F.
	Percent	*Percent*	*Percent*
60°	82	—	—
65°	70	85	—
70°	58	71	83
75°	50	60	71
80°	42	51	60
85°	36	44	51
90°	30	37	43
95°	26	32	38
100°	22	28	32

Source: Johndrew and Baker (*13*).

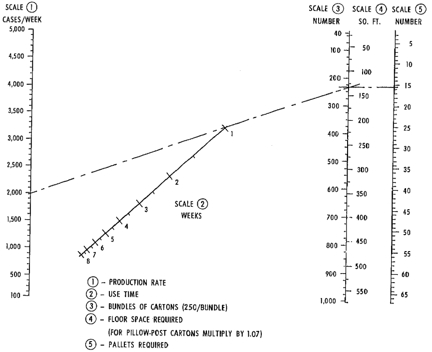


FIGURE 11.—Nomograph for determining quantity, order frequency, warehouse space, and number of pallets required for 2 x 6 molded pulp egg cartons.

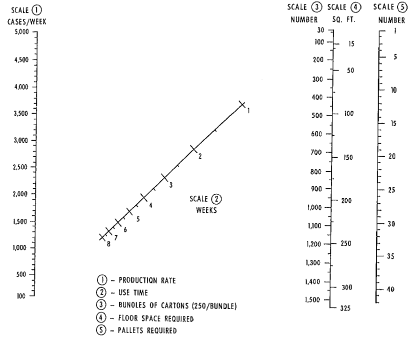


FIGURE 12.—Nomograph for determining quantity, order frequency, warehouse space, and number of pallets required for 2 x 6 chipboard egg cartons.

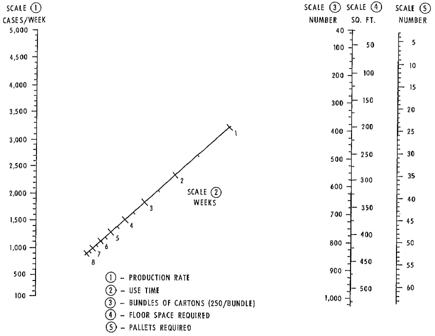


FIGURE 13.—Nomograph for determining quantity, order, frequency, and the warehouse space and number of pallets required for 3 x 4 molded pulp egg cartons.

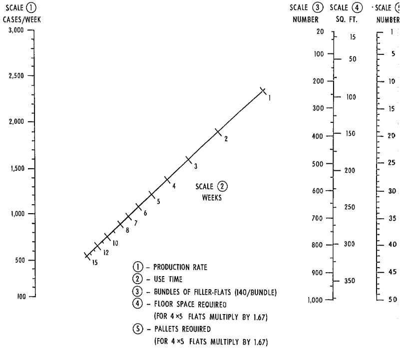
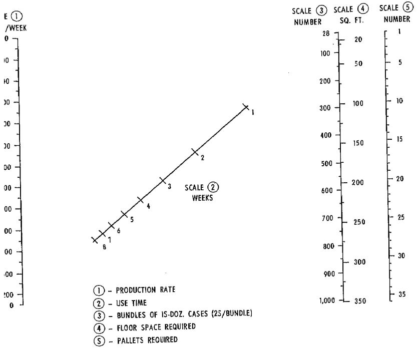


FIGURE 14.—Nomograph for determining quantity, order frequency, and the warehouse space and number of pal required for 5 x 6 filler flats.



URE 15.—Nomograph for determining quantity, order frequency, and the warehouse space and number of pallets required for 15 dozen fiber egg cases.

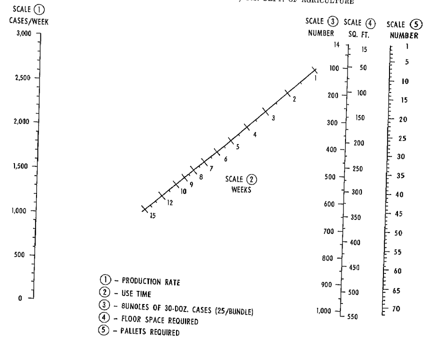


FIGURE 16.—Nomograph for determining quantity, order frequency, and the warehouse space and number of pallets required for 30 dozen fiber egg cases.

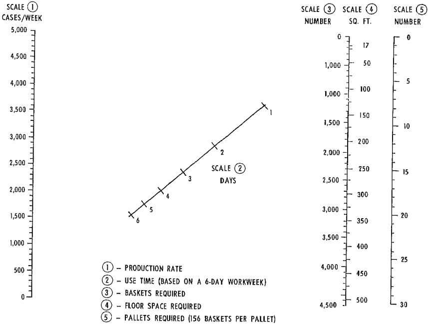


FIGURE 17.—Nomograph for determining quantity, order frequency, and the warehouse space and number of pallets required for wire baskets.

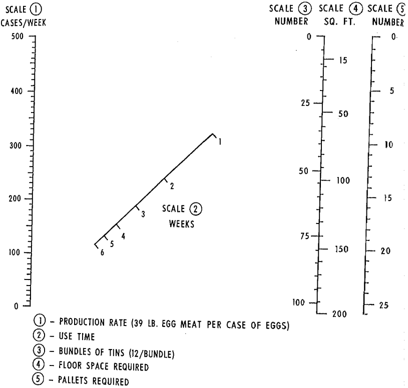


FIGURE 18.—Nomograph for determining quantity, order frequency, and the warehouse space and number of pallets required for 30-pound-capacity egg meat tins.

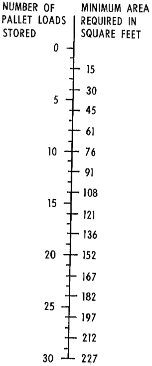
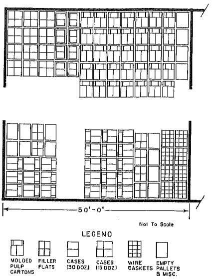


FIGURE 19.—Scale for determining minimum warehouse floor area required for storing pallet loads (36 x 48 in.) stacked two high (without use of pallet racks).



Area: 50 ft. 6 in. x 50 ft. 0 in. = 2,525 ft.^{2}

Molded pulp cartons (2 x 6)	59 spaces	@ 17.1 ft.^{2} =	1,009 ft.^{2}
One-half cases	12 spaces	@ 19.5 ft.^{2} =	234 ft.^{2}
Wire baskets	8 spaces	@ 16.9 ft.^{2} =	135 ft.^{2}
Filler flats	6 spaces	@ 15.2 ft.^{2} =	91 ft.^{2}
Cases	8 spaces	@ 15.2 ft.^{2} =	122 ft.^{2}
Empty pallets and miscellaneous	14 spaces	@ 15.2 ft.^{2} =	213 ft.^{2}
Total		=	1,804 ft.^{2}

1,804 ft.^{2} x 1.4 (aisle factor) = 2,525 ft.^{2}

FIGURE 20.—A typical packing-materials storage situation. This arrangement requires an aisle factor of 1.4.

The conditions under which eggs are held in the cooler have an appreciable effect on the cooling rate and on the design of the cooling system. Bell and Curley (*3*) found that eggs in closed fiber cases required approximately 24 hours to cool under typical cooler conditions, and that eggs on filler flats (not cased) required only 5 to 10 hours (table 2). Adequate cooling is dependent not only on the amount of refrigeration furnished but also on air circulation. To assure good circulation, pallets of incoming eggs should be positioned to provide a space of several inches between pallet loads. If cooling equipment is to be located on only one side of the cooler, as was seen in a number of plants, it should be located on the side where incoming eggs (ungraded) are to be stored to provide the best possible circulation of cool air. Cooling equipment should be located so

TABLE 2.—*Time required to cool eggs from 90° to 60° F. when packed in various types of packing materials*

Method of packing	Cooling time (hrs.)
Fiber filler flats in fiber cases with forced air cooling through openings in cases	2–5
Plastic and fiber filler flats, open stack	5–10
Formed and folded cartons, open stack; formed and folded cartons, wood case; plastic and fiber filler flats, wood case; plastic and fiber filler flats, fiber case, open	15–25
Plastic and fiber filler flats, fiber case, closed; formed and folded cartons, fiber case, closed	30+

Source: Bell and Curley (3).

that the air stream does not strike projecting objects in the room. A central duct over the aisle, with air forced to each side of the cooler room, provides good circulation.

In the producer-packer type of operation, eggs are moved directly from the laying houses to the packing plant. Wire baskets and packing materials used in packing eggs as they are gathered (classified as "in-transit" items in this report) are quite often stored in the cooler. This practice is a good one, because the materials are precooled and humidified and workers involved in these operations are required to come to the cooler to unload the eggs and pick up a fresh supply of packing materials. Storage of in-transit items in the dry storage area would require either that trucks make two separate stops or that the materials be moved some distance through the plant.

The three main factors required in determining the size and type of cooling equipment for the egg cooler are the number of eggs and other materials to be cooled each day (the potential heat load), size and type of construction of the cooler, and differences in temperature between the outside air and the air inside the cooler. For refrigeration contractors determining exact loads, a specific heat of 0.76 British thermal unit (B.t.u.) per pound and per degree Fahrenheit may be used for the eggs and 0.60 B.t.u. per pound and per degree Fahrenheit for the packing materials, or a full case average of 0.74 B.t.u. per pound per degree Fahrenheit (*3*).

Eggs, when laid, are approximately 106° F., but they generally cool several degrees in ambient air before reaching the cooler. Weights of eggs for a 30-dozen case are approximately as follows:

	Pounds per case
Pee-wees	30
Small	35
Mediums	40
Large	45
Extra large	50

To design a cooler properly for any particular location and climate, a qualified refrigeration engineer should be consulted. He would determine cooling equipment capacity and recommend proper insulation as determined by the heat load conditions prevailing in the area and by the particular volume range at which the equipment will be operating.

Determination of Cold Storage Space Requirements

As in unrefrigerated storage, the exact space requirements for cooler storage is difficult to determine. Space must be available for incoming eggs (ungraded); outgoing finished product (graded and packed eggs); in-transit items such as wire baskets, filler flats, and empty pallets; and any eggs held for breaking if in-plant egg breaking facilities are to be included in the planned facilities. The variable factors involve the regularity of egg receiving and shipping schedules; the size, number, and condition of incoming lots; the method of stacking incoming eggs; the methods of making up orders of graded eggs; and the frequency and size of outgoing shipments.

Situations having a marked effect on space needs arise when bad weather causes emergencies, or when a holiday falls on the day immediately preceding or following the weekend. For example, when a plant receives and packs daily—and a holiday falls on Monday, the eggs normally delivered on Friday are not graded and packed until Tuesday. Thus, the plant must have a storing capacity of 3 days' receipts, in addition to the supply normally held over to start the next day's operation (about one-half day's receipts).

Although such situations occur only a few times during a year, they must be provided for. Rather than building and maintaining excess storage

space for emergencies, eggs could be stacked temporarily in the aisle of the cooler. Each lot, however, should be kept separate.

Under normal operating conditions, specific areas should be allocated for storing the same items each day, thus eliminating any confusion among production personnel, management, and truckers.

The methods and equipment for handling incoming eggs are also essential in determining the space requirements. Figure 21 illustrates a common handling method. The use of a system that can be used in conjunction with pallet racks (fig. 8) permits stacks that are two pallets high, makes full use of refrigerated storage space, and reduces floorspace requirements by about half.

The nomographs in figures 22 and 23 were prepared for calculating cooler space requirements for ungraded and graded eggs.

In addition to providing space for graded and ungraded eggs, some space must be provided for in-transit items such as empty pallets, wire baskets, and filler flats. Only those to be used daily should be included in the cooler area. The space requirement for them can be determined by using the scale (fig. 19) prepared for pallet loads.

As in dry storage, illustrating all the situations for refrigerated storage to determine the space requirements would be impossible. However, the same procedure can be used to determine requirements for refrigerated space as was used to determine the dry storage space. The use factor required per pallet (figs. 57, 58, and 60–63) also provides space for circulation of air. The additional adjustment factor in the nomographs (figs. 22 and 23) are required for stacking pallet loads three high in pallet racks, and one high without racks.

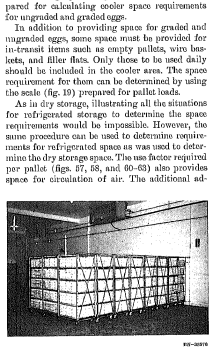


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FIGURE 21.—Eggs from laying house held in cooler awaiting grading and packing.

A layout was developed (fig. 24) to illustrate the need for additional aisle space for a production situation involving a typical supply of ungraded eggs awaiting grading, a supply of graded eggs awaiting shipment, and the usual mixture of in-transit items stored temporarily in the cooler. As in dry storage, the total space must be greater than the occupied space to permit ready access to the various items. Thus, the total square feet required for the product and for various materials must be multiplied by 1.33 to determine the cooler size.[6]

PROCESSING AREA

The processing area, where ungraded eggs are washed, graded, sized, and packed, is the most important area in the plant.[7] Most of the plant workers are assigned to this area, and the product is most frequently exposed to breakage hazards. It also has the most costly processing equipment. Thus, it provides the greatest potential for operating economies.

Since several manufacturers produce good processing equipment and each has its own particular layout requirements for efficient operation, one type of equipment was not favored over another in this report. Many plant owners request bids on equipment along with installation plans and, after evaluating each bid, choose the one best suited to their particular situation.

The layouts in figures 25 and 26 were designed for 50- by 70-ft. processing rooms equipped with different types of grading and packing equipment rated at the same 60-case-per-hour capacity. The illustrations show the adaptability and efficiency of the layouts to the room dimensions; and adequate space for work areas and equipment, smooth traffic flow, use of forklift equipment, and ready expansion.

In planning layouts for 30- to 35-case-per-hour operations (figs. 27 through 30), only slight modifications in linear dimensions for the egg process-

[6] The same procedure used in figure 20 was used in arriving at a 1.33 aisle factor.

[7] A detailed description of these operations is given in Marketing Research Reports 744 and 422 (7 and 9).

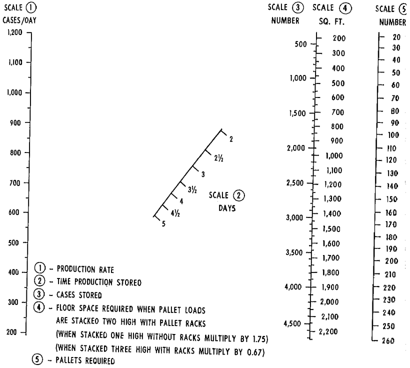

FIGURE 22.—Nomograph for determining the total number of cases of ungraded eggs to be stored and the cooler space and number of pallets required for a known daily production rate and time period.

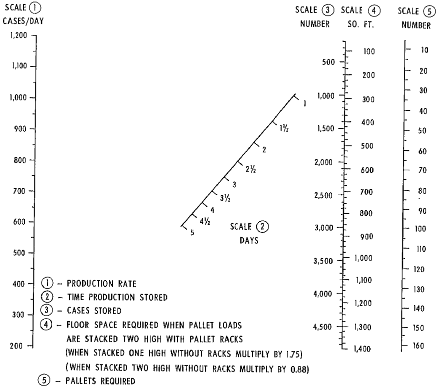

FIGURE 23.—Nomograph for determining the total number of cases of graded eggs to be stored and the cooler space and number of pallets required for a known daily production rate and time period.

ing room are needed to accommodate most types of standard mechanized egg grading and packing lines designed to handle a production load of this size, while leaving sufficient space for efficient operation and for auxiliary equipment.

The space requirement for the 30- to 35-case systems is not greatly different from that for systems with grading lines twice this capacity (figs. 25 and 26).

The many operations observed indicated that it

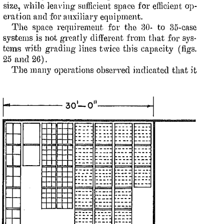

FIGURE 24.—Cooler layout arrangement of graded and ungraded eggs and a typical supply of in-transit items, with aisle design requiring a 1.33 aisle factor.

is best to plan plant dimensions and a layout that will accommodate the use of forklift trucks. This type of planning will not cause any problems, even if forklift trucks are not used at first, and will certainly make later expansion simpler.

Layouts for 120 cases per hour (figs. 31 and 32) involve making a mirror image arrangement of the 60-case layouts, and then changing the infeed and finished goods conveying systems. Production capacity at this level requires a building twice the width of the 60-case-per-hour facility.

Procedures for making the structural changes needed to expand from 35 or 60 cases per hour to 120 cases per hour are covered in the section on structural design (p. 37).

Auxiliary Devices

Occasionally, insignificant auxiliary devices can greatly increase the effectiveness of a plant that is well planned. Several of these devices are explained in the discussion that follows.

Figure 33 shows a rack for handling quantities of cartons. Each section in the rack is designed to hold one bundle of cartons. A table adjoining the rack provides a space for unwrapping cartons. The rack is mounted on wheels for easy movement to the grading line packing heads and provides temporary storage for small quantities of cartons. Use of the rack eliminates damage to unwrapped cartons that would otherwise be stored on the floor (fig. 34). Its use also contributes to orderliness and reduces labor when loading carton chutes. A table at working level for half cases (fig. 35) brings the next container up to a convenient reach. Use of this table eliminates the need for the operator to bend over to obtain the next container, thereby reducing makeup time for the container.

Two good types of containers for trash (such as wrappings and twine) are illustrated in figure 36. One is a 55-gallon drum on a pallet; and the other, a wire cage mounted on a 36- by 48-in. pallet.

Operating Procedures

In planning the processing area layout, an effective combination of operating procedures was selected for each layout. The legends for figures 25 through 32 identify the location of the area in which the activities take place; the location of the auxiliary equipment associated with each

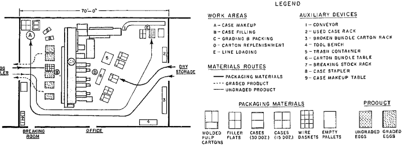

FIGURE 25.—A 50- by 70-foot egg processing room layout with a grading and packing line (C1) designed for a production rate of 60 cases per hour.

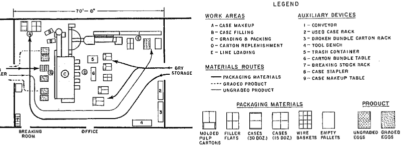

FIGURE 26.—A 50- by 70-foot egg processing room layout with a grading and packing line (C) designed for a production rate of 60 cases per hour.

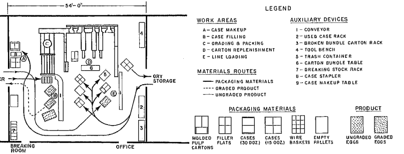

FIGURE 27.—A 50- by 54-foot egg processing room layout with a grading and packing line rated at 30 cases per hour.

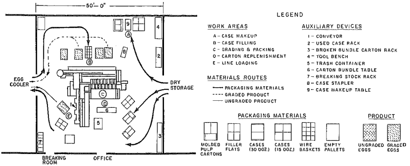

FIGURE 28.—A 50- by 50-foot egg processing room layout with a grading and packing line rated at 35 cases per hour.

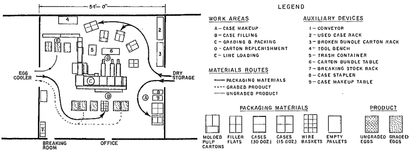

FIGURE 29.—A 50- by 54-foot egg processing room layout with a grading and packing line rated at 35 cases per hour.

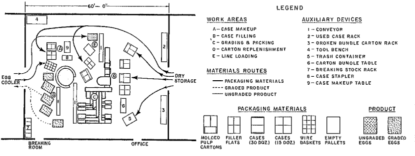

FIGURE 30.—A 50- by 60-foot egg processing room layout with a grading and packing line rated at 35 cases per hour.

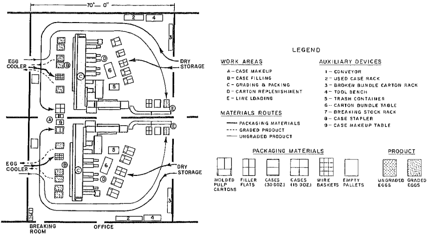

FIGURE 31.—An egg-processing room layout, 70 ft. by 100 ft., with separate grading and packing lines, each rated at 60 cases per hour.

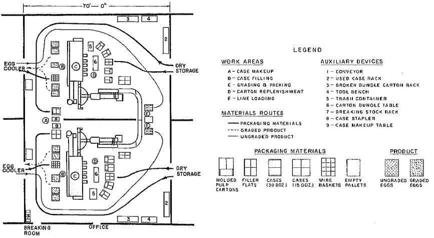

FIGURE 32.—An egg-processing room layout, 70 ft. by 100 ft., in which two 60-case-per-hour grading and packing lines are served by one infeed conveyor for a 120-case-per-hour system.

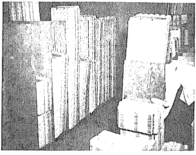

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FIGURE 33.—Carton rack and table for opening and unpacking carton containers.

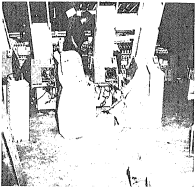

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FIGURE 34.—Cartons stacked on the floor are subject to damage.

activity; and the product and packing material, along with the route of each.

At the point where incoming eggs are loaded onto the grading and packing line, a roller conveyor is provided to hold a pallet load of eggs. As eggs are fed onto the line, such items as filler flats and pallets are accumulated in an assigned space for continuous removal.

Cases and half cases are brought to the case makeup area in pallet loads. The output of made-up cases is coordinated with the packing operation. Cases move directly to the casing station so that little time is lost in obtaining them. Wire baskets are brought from the in-transit storage part of the cooler, by the pallet load, and placed in line with pallets of filled cases. The baskets are positioned as near as possible to the point where they are filled. Empty pallets are supplied as necessary from the line-loading operation.

Cartons that are used in large quantities, as well as filler flats, are delivered in pallet loads to the packing materials supply area. Items that are used in small quantities are brought into the area by handtruck. When two grading and packing lines are used, an additional table is required for bundle breakup.

As graded eggs are packed, they are palletized near the cooler. As soon as a pallet is loaded, the eggs are refrigerated. Small volume items, such as

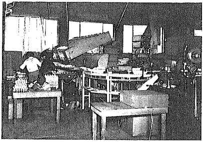

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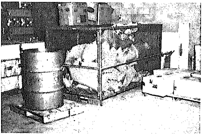
FIGURE 35.—A table for bundles of cases at makeup machine reduces labor



BN-33496
FIGURE 36.—Trash containers reduce floor litter and cleanup labor.

undergrade eggs, may be moved into the cooler by two-wheel handtrucks. Space for these items is not shown on the layouts.

Equipment should be spaced at least 3 feet from walls or other equipment to permit convenient and regular servicing and cleaning, or repair and adjustment.

The walls in the processing area should be impervious to water to permit periodic cleanup. The floor should be sloped to a drain near the processing machines to permit washing down the machines after each shift.

GUIDELINES FOR AN EGG GRADING AND PACKING PLANT LAYOUT

In planning and preparing an efficient layout, the following points should be considered.

1. Provide a minimum travel distance to cooler and dry storage areas.
2. Minimize crossflow of product and packing materials in high-activity areas.
3. Provide ample space to maneuver and position pallets by forklift truck.
4. Provide space around machines for cleaning, servicing, and repair.
5. Provide space for all auxiliary equipment.
6. Allow space for machine modification.
7. Provide an arrangement that is compatible with equipment and facilities needed for expansion.
8. Locate the floor drain to allow for flexibility in placing equipment.
9. If rooms are added, they should be designed so as not to extend into the processing area.
10. Install utilities, where they will permit future modification of facilities without major structural change.

OFFICE, EMPLOYEE FACILITIES, AND BREAKING ROOM

The office, restrooms, and breaking room and freezer, if a breaking operation is considered, should be located on one side of the building. This arrangement will facilitate future expansion of the building and the common use of plumbing and sewage facilities. In addition, it will minimize space-wasting projections into the processing area and possible interference with flow patterns. Figure 37 illustrates these areas, designed as a unit, located at the front of the building.

The arrangement provides an entry into the front of the building and limits, to one point, the entry into the processing area. The timeclock can be placed at the entrance to the employee facilities. With this arrangement one person in the office can monitor the timeclock, the entry of employees into the rest area, and the entrance of visitors. The same person can also handle over-the-counter sales and observe the operation of the processing area. One-way glass can provide office privacy.

The general office provides space for two desks (only one desk is shown in fig. 37), a counter, and office equipment. The adjoining private office and restroom are optional. If the sales, bookkeeping, and accounting are to be done at the plant, the additional space (optional private office) will be required for general office work.

Personnel Facilities

In recent years the trend has been toward providing plant workers with more comfortable surroundings, both at their work stations and in the rest areas. The design of these facilities and the way in which they are maintained reflect the attitude of management toward the employee. Better worker morale, greater productivity, improved workmanship, and lower labor turnover have resulted.

Of the plants visited, the personnel facilities ranged from a table and chairs in one corner of the processing area to a complete lunchroom with free meals for the employees. Many plants maintained well-lighted, airy rooms of sufficient size to accommodate all employees. Provisions for feeding the employees included either food vending machines or cooking facilities with dishes and a sink with hot and cold water. The layout illustrated in figure 37 provides ample space for personnel needs. Each of the restrooms adjoining the employee lounge is adequate for up to 15 people. Most local codes require that eating facilities and toilets be separated by a vestibule, as illustrated in the layout. The vestibule can be utilized for

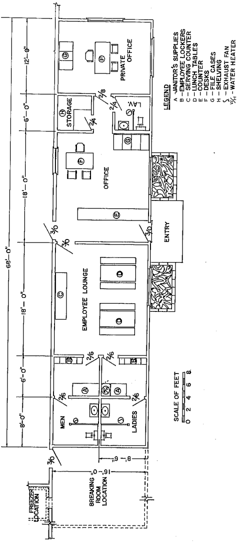


FIGURE 37.—Suggested location and layouts for adjoining office and employees' facilities (and suggested breaking room and freezer, if required).

employee lockers, water heater, storage space for supplies used in the area, and cleaning materials. The restrooms must be provided with an exhaust fan or with windows opening to the outside.

Breaking Room

Space for a breaking room in this facility is optional and is indicated by broken lines in figure 37. An equipment layout for the area was not developed at the time this study was made because sufficient data on successful batch pasteurization of small quantities of liquid whole egg were not available. Since then, however, research completed by the Department in cooperation with the University of California (*4*) shows that small quantities of liquid whole egg (100 to 200 gallons) can be pasteurized effectively and economically. Equipment companies now have batch pasteurizing systems designed to handle small quantities of liquid whole egg within the space proposed in figure 37.[8]

If a breaking room is added, it should adjoin the office and employee facilities area along the front of the building and have a connecting doorway to the processing area.

If a blast-freezing facility is to be included, a prefabricated type is suggested (fig. 38). One of two doorways in the corner of the breaking room can lead to the processing room and the other to the freezer (fig. 39). Refrigeration requirements for freezing the liquid whole egg volume that can be expected from a shell egg packing operation of this size has been reported in earlier research (*8*).

THE OVERALL LAYOUT

To plan a good plant layout the needs of each of the component areas, along with their interrelationship, must first be determined and then the most efficient arrangement of areas developed. Probably the most important consideration in plant planning, and one most frequently overlooked, is the future expansion potential. The plant design should permit expansion readily and economically. One side and one end of the building should be free of permanent installations such as, compressors, septic tanks, toilets, drain fields,

[8] See figure 64 for suggested breaking room layout.

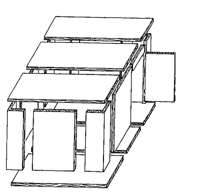


FIGURE 38.—Prefabricated-type freezer suggested for freezing liquid whole egg if breaking operations are considered.

offices, and loading docks to permit addition of building units without relocating these auxiliary facilities.

Other factors to consider in the overall plan include (1) accessibility to related plant areas, (2) ease with which the layout can be rearranged, (3) accessibility of the cooler to incoming eggs, (4) layout of roadways and parking areas, (5) ease and simplicity of materials handling operations, (6) working conditions and employee satisfaction, (7) the ease with which management can supervise all operations, (8) overall appearance, and (9) utilization of and adaptability to local conditions (topography, climate, access roads, and community conditions).

In planning the overall plant arrangement, a 52-foot width (outside dimension) was chosen because it lends itself to good arrangement of storage space and does not restrict arrangement of equipment.

In the recommended layout the areas were arranged in a straight line (fig. 39), with the processing room in the center and storage areas on each end. The layout was designed so that the cooler is located close to the point where graded and packed eggs accumulate, and the dry storage is adjacent to the point of packing materials use. Offices, facilities requiring plumbing, and fixed equipment are placed at the front of the building,

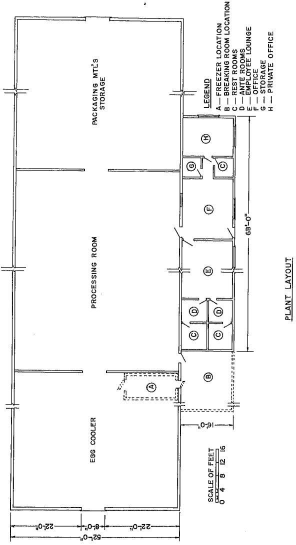


FIGURE 39.—Suggested location of freezer and breaking room, if breaking operations are considered.

and the loading dock is placed at the cooler end. This arrangement leaves one end of the plant and the back area free for future expansion and provides easy access to the processing area from all areas within the plant. Since most of the activities and employees are in this area, the convenience of the area is a prime consideration. To reach the employee lounge, employees must use the office entrance aisle. Thus employee movement can be monitored and wall space will not need to be broken up.

SITE SELECTION

Several of the plants studied had inadequate parking space; others had poor accessibility for trucks. One or two had poor drainage. Location was a serious problem for some plants (when located adjacent to production operations) because areas around the site had become heavily populated and complaints were registered with local governments about offensive odors. Such problems can be forestalled by selecting the site carefully.

The site selected must provide sufficient space for an efficient arrangement of the overall facility. Under ideal circumstances space should be adequate to drive completely around the structure within the property boundary lines. The site should have adequate room for expansion, for employee parking, and for offstreet maneuvering of trucks (fig. 40).

The selection of the site is influenced by (1) initial cost of the land, (2) clearing and grading the site, (3) construction of roads, (4) bringing in the utilities, (5) fencing or landscaping the property, (6) cost of transporting eggs and packing materials to and from the plant, (7) availability of labor, and (8) prevailing rates for taxes and insurance.

The relative proximity of the egg supply should also be considered, since locating the processing operation at or near the production site has been found to be desirable. In such a location, the facility must be located in proper relation to the prevailing wind and pedestrian traffic routes to prevent possible contamination of the flock. When plants are located in rural areas that have no sewage treatment facilities, the cost of disposing waste from the egg washer in a system separate from the sanitary sewer must be considered.

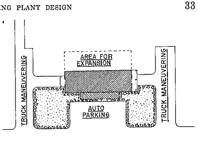


FIGURE 40.—Plot plan that provides basic needs for plant site.

STRUCTURAL DESIGN OF PLANT AND AUXILIARY FACILITIES

A shell egg processing plant of the type and capacity described must be considered, essentially, as a "food processing business," rather than as an "agricultural operation," even though it is in a rural location and is near or a part of egg producing facilities. Because of the substantial investment required and the number of employees that are involved in the plant operation, it becomes a significant contribution to the economy of the country.

Functional Requirements

Efficiency of operation, ease of maintenance, and durability under the conditions of service are all functional requirements in building use (*16*). A good start on the first requirement is made by regarding the building as a shelter only. The building, or shelter, is simply put around and over an operation that is laid out without regard for anything but the efficiency of the operation.

Surrounding the operation with walls presents relatively few problems. The ceiling, however, should be considered carefully. The first aspect to be considered is: "How high should the ceilings be?" The answer is simple: A minimum vertical dimension of 14 feet is recommended for the stack-

ing of pallet loads (figs. 48–63) and for storage facilities that have been developed around a forklift operation.

The height of the ceiling should not be considered independently, however. All features in the structural design of a building should be studied as to their interrelationships with all other features that may be involved in the functional efficiency of building use (*15*). In the design for the ceiling and roof system, for example, providing an interior that will be free of obstructions should be considered. A clear interior contributes to both efficiency and ease of maintenance.

Figure 41 illustrates the difficulties presented by interior supports. The man in the foreground, almost obscured as he stoops to service the equipment, is standing between the supporting column and the egg conveyor. To reach this position, he had to climb over the conveyor. The presence of the column created a situation of inconvenience and a possibility of personal injury to the worker, factors which may reduce the care of equipment in this isolated position. The position of the equipment was not planned for an efficient layout; it was necessitated by the location of the column. In situations where the location of the column does not affect the efficiency of the initial layout, it may do so later when the layout is modified or new equipment is added.

Ease of maintenance, the second functional requirement, is desirable not only as an end in itself, but also for its contribution to general efficiency, safety, and pleasant working conditions. Cleaning storage areas, although not a particular problem, should be considered in designing the plant. Sloped floors make stacking difficult, especially high stacking with forklifts, and are not recommended in storage areas. Walls and partitions between storage and other areas should be of smooth construction to reduce dust problems. One or more trapped drains located in storage areas permit ease in cleaning by sweeping water into the drains.

Normally the processing area requires more frequent cleaning than other areas because of the nature of the operation and the more intensive use of a limited floorspace. Cleaning floors presents little problem since drains for machine waste water are usually available and conveniently located. It is recommended that the exterior walls be placed on curbs that extend 6 inches above the floor. This arrangement facilitates cleaning and reduces water contact with the wall lining (fig. 65). An impervious and easily cleaned wall surface may be applied over the interior lining if it should become necessary at some later time to meet changing building use or more stringent sanitation requirements. Electrical and heating equipment, as well as walls and other structural features, should be of a type that will permit the occasional use of hoses to clean the processing area.

Durability under the conditions of service in an egg packing plant, the third functional requirement, is largely protection against physical damage by materials-handling equipment. Figure 42 illustrates a good protective measure for door and wall. The opening in the masonry wall for the cooler door is framed with steel angles to prevent damage from the forklift (fig. 66). A nominal 4-by 4-inch wood member is mounted at the base of the wall to prevent damage from contact by either the pallets or the forklift trucks (fig. 67). This bumper rail is a good feature for any type of wall construction. A common method of preventing damage to doors, which is not shown here, is to cover doors with heavy sheet metal.

The handling of materials being delivered to or hauled away from the building is an important aspect of functional design. A dock at truck-bed level is most desirable. The dock may be recessed (pit) type, or it may be a raised platform. The aboveground-level platform is a good approach

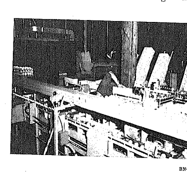


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FIGURE 41.—Column interference can affect layout efficiency and servicing schedules.

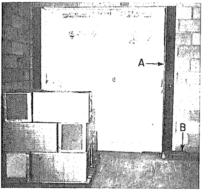

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FIGURE 42.—Damage to door of cooler and wall minimized by (A) steel angle framing and (B) bumper rail.

where a cut and fill situation exists. Terrain usually dictates the type of loading dock selected.

Loading docks, depending on the type selected, present their own particular design requirements. First, some method must be provided to absorb the shock when trucks strike the dock. Second, drainage must be provided for the pit of recessed docks (fig. 68). Third, allowance must be made for the difference in the angle of the truck body as it affects the contact point of a truck with the dock. This problem is of particular importance for recessed docks (fig. 43). Proper allowance must also be made for the maneuvering of trucks into the dock area (fig. 44).

Design Loads

The example design for a 60-case-per-hour operation, presented in the next section, has followed the provisions of the 1964 Uniform Building Code (*12*). A roof live load of 20 pounds per square foot was used (fig. 69). The windload was taken as 15 pounds per square foot on the vertical projection. Since the plywood diaphragm construction system used was relatively lightweight, windload requirements were found to be more critical than those for earthquake.

Floor slabs on grade present special design problems. Particular attention is required for prevention of damage by heavy forklift trucks. Professional assistance is desirable in locations with difficult soil conditions (fig. 65).

Employee space may be handled as conventional construction (fig. 70). Particular attention should be devoted to meeting local and health department and building code requirements for employee health and safety in restroom and lunchroom facilities.

EXAMPLE DESIGN

An artist's conception of an example design is shown in figure 45. The building illustrated is shown in cross section in figure 69. Overall construction economy has been sought by maximizing the utilization of building components as structural members to the greatest extent possible, and by minimizing the number of crafts required in construction. Provision for flexibility in use and for expansion alternatives have been incorporated into the design by use of the movable interior wall shown in figures 46 and 67.

Roof and Wall System

A plywood roof deck on a clear-span truss system was selected for the example design (fig. 69) (*1*). Stud walls (*6*) with a structural plywood lining and corrugated metal siding complete the

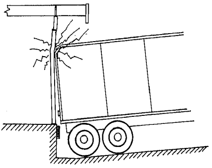

FIGURE 43.—Top of truck strikes dock roof support if driving slope is too steep.

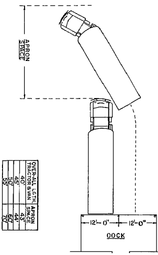

FIGURE 44.—Apron space required for truck maneuvering.

building (fig. 67). The primary design concept employed was that of diaphragm action (*2*) commonly accomplished by proper design of the siding material and its fastenings.

The interior lining was used as a structural member in the design of the building (*18*), as being the most economical approach, since a complete lining was considered essential in the processing and cool storage areas. In addition, it permits ease in cleaning and maintenance.

When the interior lining is used as a structural member, a variety of materials from which to select an exterior covering is possible. Since the exterior covering should be as maintenance free as possible, the greater freedom of choice of materials can provide additional economy in construction.

The plywood nailing schedule should be observed as closely as possible in the development of diaphragm action (fig. 66) (*17*). For both the roof and wall lining, 8d common nails spaced 4 inches apart at wall and roof boundaries, 6 inches apart at other panel edges, and 12 inches apart at intermediate supports must be used.

In a diaphragm design, the shear elements must be anchored securely to provide insurance against overturning. This design feature is readily apparent in figures 47 and 67, which shows an end wall anchor bracket. In addition, clearance is provided around the anchor bracket bolts where they pass through the sill. The normal sillbolts are still required for sliding resistance. Design should also assure continuity of the top plates since they act as the flanges of a very deep beam formed with the roof diaphragm at the beam web. The end walls are the supports for this beam in resisting lateral forces (*21*).

The one-craft concept is illustrated, figures 67 and 69 by the combination wood metal truss which permits complete roof system construction by carpenters. Any conventional roof system is acceptable as long as a proper roof or ceiling diaphragm is provided.

Floor Slabs

Inadequately designed floors are a major source of owner dissatisfaction. A cracked floor slab is unsightly, presents sanitation problems, and if badly cracked, can be detrimental to operating efficiency. The advice of a competent engineer familiar with local soil conditions is well worth the cost in preventing needless failures in floors.

A basic requirement, commonly known but often disregarded, is the necessity to limit the size of continuous pours. If this requirement is followed, surface cracking that is caused by shrinkage will be limited.

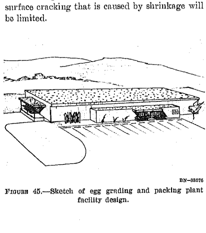

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FIGURE 45.—Sketch of egg grading and packing plant facility design.

[n]ormal flexural cracking on the bottom of the [slab] is not particularly detrimental, but cracking [on] the surface because of loads carried must be [con]trolled by adequate reinforcement. The floor [load]s encountered in this type of operation, par[ticu]larly from forklift trucks, are heavier than [tho]se with which many owners are familiar. The [min]imum temperature steel requirement is ade[qua]te for forklift trucks (2,000-pound capacity), [und]er most soil conditions, if a 6-inch slab is used [...]. Additional reinforcement is necessary for [whe]el loads at the slab corners (*26*). Extra diag[ona]l bars are recommended at the corners (*27*). [Bar]s must extend diagonally from the corner a dis[tan]ce equal to one-half of the longest side of a given [sect]ion. Welded wire mesh is suggested for rein[forc]ement of the main slab. This mesh limits the [rein]forcement weight to a minimum (*27*), yet pro[vide]s an even distribution of steel for crack con[trol] (fig. 65).

[D]ifferential settlement between floor sections [may] be prevented by keying the sections during [the] pouring operations (*19*). Keying is inexpen[sive] and aids in preventing corner uplift on [spec]ially loaded slabs. It also provides for shear [tran]sfer between sections to bridge minor sub[gra]de deficiencies which might otherwise lead to [seri]ous floor problems.

Building Size Modification

[T]he 60-case-per-hour operation was chosen for [desi]gn purposes as being representative of many [pac]king facilities. Other common sizes, based on [mac]hine capacity, are 35 cases per hour and 120 [case]s per hour. The 35-case-per-hour operation re[quir]es merely scaling down the example design [by r]educing the length of the building.

[T]he packing plant handling 120 cases per hour [can] be laid out by adding the mirror image of the [b]ase plant. One exterior wall will then become [an] interior wall with a doubled dead load and [live] load. Provisions to carry the roof across wall [open]ings and to supply an adequate foundation [for] this wall must be planned carefully. The ad[diti]on of the adjacent roof system and the con[nect]ion of the tie plates must be planned in ad[van]ce to provide building integrity in resisting [late]ral loads.

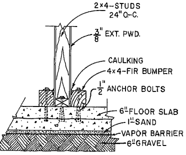

FIGURE 46.—Interior wall detail at floor.

OTHER MECHANICAL CONSIDERATIONS

Electrical Panels

The electrical requirements of the plant can be determined most easily by using information provided by the machine manufacturer, as well as the help of the power-use adviser employed by the local utilities company. These services are generally available to customers, free of charge, in the interest of providing adequate and trouble-free electrical connections. Recommendations on lighting requirements for the plant may be obtained at the same time.

Waste Water and Sewage Disposal

The sewage generated results from limited food preparation and restroom use only. It should be handled separately from the waste water from the egg washing machine and other cleaning water. When the sewage cannot be discharged into city lines, a septic tank may be designed for this purpose (*22*).

The disposal of waste water from egg washing presents more of a problem than the disposal of other sewage, because of both its nature and the greater volume involved. This waste water contains very little organic matter, which means that it need not be regarded as a health hazard in the same way as sewage containing human excreta. Moreover, it contains a detergent-sanitizer formu-

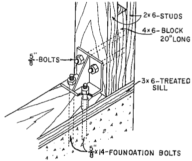

FIGURE 47.—End wall anchor bracket used at outside corners and door openings.

lation from the egg washing operation. Waste water from a 60-case-per-hour operation is generated at a minimum rate of 200 gallons per hour when water is not reused.

The volume of waste water produced makes septic tanks prohibitive in cost. They are largely ineffective at any rate of flow because the detergent-sanitizer precludes any bacterial activity. Waste water may be disposed of by tile drain fields when soil characteristics permit. In areas of tight soils and poor drainage, a lagoon or shallow detention reservoir is suggested. This lagoon should be about 3 feet deep and have enough capacity for 30 days' retention. Within 30 days, the degradation at the overflow end should make the effluent safe. Sufficient percolation and evaporation will normally occur so that there will be little or no overflow.

Heating

Heating requirements are best determined by local conditions. They will, of course, vary according to construction and insulation selected. In areas having a relatively mild climate, many operators have found that heated floor pads at work stations, plus occasional overhead lamps, provide a very satisfactory degree of worker comfort.

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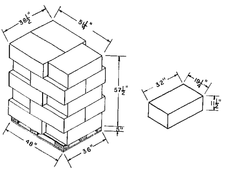
APPENDIX

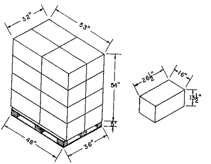


Quantity, weight, and space values:

Number cartons per bundle	250.
Number bundles per tier	3.
Number tiers per pallet	5.
Number bundles per pallet	15.
Weight cartons and pallet	488 lb.
Capacity in finished goods per pallet	125 cases.
Overall dimensions	51¼ x 38¼ x 63 in.
Space that should be set aside for each pallet to provide clearance between lanes and irregularity in stocking includes a use factor.[1]	55¼ x 44¼ in., or 17.1 sq. ft.

[1] USE FACTOR.—The additional square feet of floorspace required to provide 6 inches of clearance between lanes of stacked materials, and 2 inches of clearance at each end of the loaded pallet. This additional space allows for irregular stacking of bundles on pallets, and easy in-and-out traffic for each lane with minimum hazard of collision with adjoining stacks.

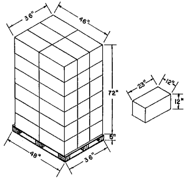
FIGURE 48.—Stacking pattern and dimensions for bundles of molded pulp egg cartons (2x6).



Quantity, weight, and space values:	
Number cartons per bundle	250.
Number bundles per tier	4.
Number tiers per pallet	4.
Number bundles per pallet	16.
Weight cartons and pallet	390 lb.
Capacity in finished goods per pallet	133 cases.
Overall dimensions	53 x 36 x 59 in.
Space that should be set aside for each pallet to provide clearance between lanes and irregularity in stacking includes a use factor.[1]	57 x 42 in., or 16.6 sq. ft.

[1] USE FACTOR.—The additional square feet of floorspace required to provide 6 inches of clearance between lanes of stacked materials, and 2 inches of clearance at each end of the loaded pallet. This additional space allows for irregular stacking of bundles on pallets, and easy in-and-out traffic for each lane with minimum hazard of collision with adjoining stacks.

FIGURE 49.—Stacking pattern and dimensions for palletized bundles of molded pulp egg cartons (3x4).

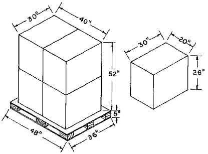


Quantity, weight, and space values:

Number cartons per bundle	250.
Number bundles per tier	6.
Number tiers per pallet	6.
Number bundles per pallet	36.
Weight cartons and pallet	1,299 lb.
Capacity in finished goods per pallet	300 cases.
Overall dimensions	48 x 36 x 77 in.
Space that should be set aside for each pallet to provide clearance between lanes and irregularity in stacking includes a use factor.[1]	52 x 42 in., or 15.2 sq. ft.

[1] USE FACTOR.—The additional square feet of floorspace required to provide 6 inches of clearance between lanes of stacked materials, and 2 inches of clearance at each end of the loaded pallet. This additional space allows for irregular stacking of bundles on pallets, and easy in-and-out traffic for each lane with minimum hazard of collision with adjoining stacks.

FIGURE 50.—Stacking pattern and dimensions for palletized bundles of chipboard egg cartons (2 x 6).

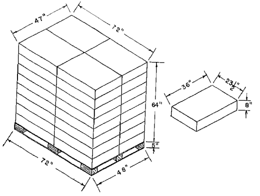


Quantity, weight, and space values:

Number cans per package	12.
Number packages per tier	2.
Number tiers per pallet	2.
Number packages per pallet	4.
Weight cans and pallet	175 lb.
Capacity per pallet in finished goods	1,200 cases.
Overall dimensions	48 x 36 x 57 in.
Space that should be set aside for each pallet to provide clearance between lanes and irregularity in stacking includes a use factor.[1]	52 x 42 in., or 15.2 sq. ft.

[1] USE FACTOR.—The additional square feet of floorspace required to provide 6 inches of clearance between lanes of stacked materials, and 2 inches of clearance at each end of the loaded pallet. This additional space allows for irregular stacking of bundles on pallets, and easy in-and-out traffic for each lane with minimum hazard of collision with adjoining stacks.

FIGURE 51.—Stacking pattern and dimensions for palletized packages of meat containers (tin).

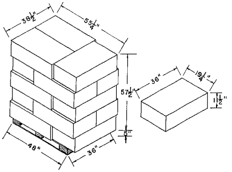


Quantity, weight, and space values:

Number cases per bundle	20.
Number bundles per tier	4.
Number tiers per pallet	8.
Number bundles per pallet	32.
Weight cases and pallet	1,060 lb.
Capacity in finished goods per pallet	640 cases.
Overall dimensions	47 x 72 x 69 in.
Space that should be set aside for each pallet to provide clearance between lanes and irregularity in stacking includes a use factor.[1]	51 x 78 in., or 27.63 sq. ft.

[1] USE FACTOR:—The additional square feet of floorspace required to provide 6 inches of clearance between lanes of stacked materials, and 2 inches of clearance at each end of the loaded pallet. This additional space allows for irregular stacking of bundles on pallets, and easy in-and-out traffic for each lane with minimum hazard of collision with adjoining stocks.

FIGURE 52.—Stacking pattern and dimensions for palletized bundles of fiber egg cases (30 dozen each).

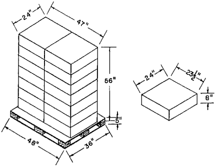


Quantity, weight, and space values:

Number cartons per bundle	250.
Number bundles per tier	3.
Number tiers per pallet	5.
Number bundles per pallet	15.
Weight cartons and pallet	530 lb.
Capacity in finished goods per pallet	125 cases.
Overall dimensions	55¼ x 38¼ x 63 in.
Space that should be set aside for each pallet to provide clearance between lanes and irregularity in stacking includes a use factor.[1]	59¼ x 44½ in., or 18.3 sq. ft.

[1] USE FACTOR.—The additional square feet of floorspace required to provide 6 inches of clearance between lanes of stacked materials, and 2 inches of clearance at each end of the loaded pallet. This additional space allows for irregular stacking of bundles on pallets, and easy in-and-out traffic for each lane with minimum hazard of collision with adjoining stacks.

FIGURE 53.—Stacking pattern and dimensions for palletized bundles of molded pulp egg cartons (2 x 6 pillar post).

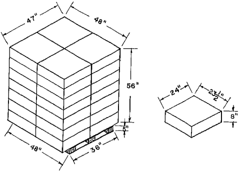


Quantity, weight, and space values:

Number half-cases per bundle	25.
Number bundles per tier	2.
Number tiers per pallet	7.
Number bundles per pallet	14.
Weight half-cases and pallet	385 lb.
Capacity in finished goods per pallet	175 cases.
Overall dimensions	48 x 36 x 61 in.
Space that should be set aside for each pallet to provide clearance between lanes and irregularity in stacking includes a use factor.[1]	52 x 42 in., or 15.2 sq. ft.

[1] USE FACTOR.—The additional square feet of floorspace required to provide 6 inches of clearance between lanes of stacked materials, and 2 inches of clearance at each end of the loaded pallet. This additional space allows for irregular stacking of bundles on pallets, and easy in-and-out traffic for each lane with minimum hazard of collision with adjoining stacks.

FIGURE 54.—Stacking pattern and dimensions for palletized bundles of fiber egg cases (15 dozen each).

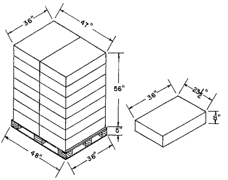


Quantity, weight, and space values:

Number half-cases per bundle	25.
Number bundles per tier	4.
Number tiers per pallet	7.
Number bundles per pallet	28.
Weight half-cases and pallet	738 lb.
Capacity in finished goods per pallet	350 cases.
Overall dimensions	48 x 48 x 72 in.
Space that should be set aside for each pallet to provide clearance between lanes and irregularity in stacking includes a use factor.[1]	52 x 54 in., or 19.5 sq. ft.

[1] USE FACTOR.—The additional square feet of floorspace required to provide 6 inches of clearance between lanes of stacked materials, and 2 inches of clearance at each end of the loaded pallet. This additional space allows for irregular stacking of bundles on pallets, and easy in-and-out traffic for each lane with minimum hazard of collision with adjoining stacks.

FIGURE 55.—Stacking pattern and dimensions for palletized bundles of fiber egg cases (15 dozen each).

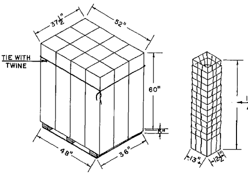


Quantity, weight, and space values:

Number cartons per bundle	25.
Number bundles per tier	2.
Number tiers per pallet	7.
Number bundles per pallet	14.
Weight full cases and pallet	580 lb.
Capacity in finished goods per pallet	350 cases.
Overall dimensions	48 x 36 x 61 in.
Space that should be set aside for each pallet to provida clearanca between lanes and irregularity in stacking includes a use factor.[1]	52 x 42 in., or 15.2 sq. ft.

[1] USE FACTOR.—The additional square feet of floorspace required to provide 6 inches of clearance between lanes of stacked materials, and 2 inches of clearance at each end of the loaded pallet. This additional space allows for irregular stacking of bundles on pallets, and easy in-and-out traffic for each lane with minimum hazard of collision with adjoining stacks.

FIGURE 56.—Stacking pattern and dimensions for palletized bundles of fiber egg cases (30 dozen each).

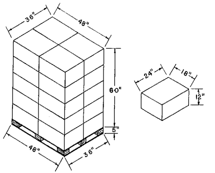


Quantity, weight, and space values:

Number baskets per stack	13.
Number stacks per pallet	12.
Number baskets per pallet	156.
Weight baskets and pallet	940 lb.
Capacity in finished goods per pallet	78 cases (30 doz. each).
Overall dimensions	52 x 37½ x 65 in.
Space that should be set aside for each pallet to provide clearance between lanes and irregularity in stacking includes a use factor.[1]	56 x 43½ in., or 16.9 sq. ft.

[1] USE FACTOR.—The additional square feet of floorspace required to provide 6 inches of clearance between lanes of stacked materials, and 2 inches of clearance at each end of the loaded pallet. This additional space allows for irregular stacking of bundles on pallets, and easy in-and-out traffic for each lane with minimum hazard of collision with adjoining stacks.

FIGURE 57.—Stacking pattern and dimensions for palletized stacks of wire baskets (15 dozen each).

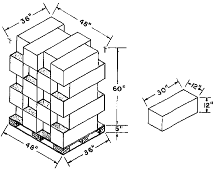


Quantity, weight, and space values:

Number filler flats per bundle	140.
Number bundles per tier	4.
Number tiers per pallet	5.
Number bundles per pallet	20.
Weight filler flats and pallet	475 lb.
Capacity in finished goods per pallet	200 cases.
Overall dimensions	48 x 36 x 65 in.
Space that should be set aside for each pallet to provide clearance between lanes and irregularity in stacking includes a use factor.[1]	52 x 42 in., or 15.2 sq. ft

[1] USE FACTOR.—The additional square feet of floorspace required to provide 6 inches of clearance between lanes of stacked materials, and 2 inches of clearance at each end of the loaded pallet. This additional space allows for irregular stacking of bundles on pallets and easy in-and-out traffic for each lane with minimum hazard of collision with adjoining stacks.

FIGURE 58.—Stacking pattern and dimensions for palletized bundles of filler flats (5 x 6).

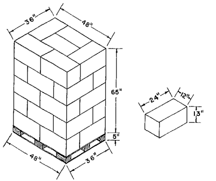


Quantity, weight, and space values:

Number filler flats per bundle	120.
Number bundles per tier	4.
Number tiers per pallet	5.
Number bundles per pallet	20.
Weight filler flats and pallet	415 lb.
Capacity in finished goods per pallet	120 cases.
Overall dimensions	48 x 36 x 65 in.
Space that should be set aside for each pallet to provide clearance between lanes and irregularity in stacking includes a use factor.[1]	52 x 42 in., or 15.2 sq. ft.

[1] USE FACTOR.—The additional square feet of floorspace required to provide 6 inches of clearance between lanes of stacked materials, and 2 inches of clearance at each end of the loaded pallet. This additional space allows for irregular stacking of bundles on pallets, and easy in-and-out traffic for each lane with minimum hazard of collision with adjoining stacks.

FIGURE 59.—Stacking pattern and dimensions for palletized bundles of filler flats (4 x 5).

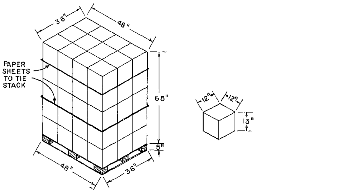


Quantity, weight, and space values:

Number cases per tier	6.
Number tiers per pallet	5.
Number cases per pallet	30.
Weight cases and pallet	1,425 lb.
Overall dimensions	48 x 36 x 70 in.
Space that should be set aside for each pallet to provide clearance between lanes and irregularity in stacking includes a use factor.[1]	52 x 42 in., or 15.2 sq. ft.

[1] USE FACTOR.—The additional square feet of floorspace required to provide 6 inches of clearance between lanes of stacked materials, and 2 inches of clearance at each end of the loaded pallet. This additional space allows for irregular stacking of bundles on pallets, and easy in-and-out traffic for each lane with minimum hazard of collision with adjoining stacks.

FIGURE 60.—Stacking pattern and dimensions for palletized full fiber cases of eggs (30 dozen each).

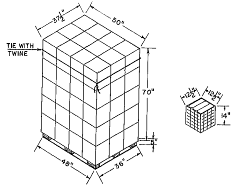


Quantity, weight, and space values:

Number half-cases per tier	12.
Number tiers per pallet	5.
Number cases per pallet	30.
Weight cases and pallet	1,455 lb.
Overall dimensions	48 x 36 x 70 in.
Space that should be set aside for each pallet to provide clearance between lanes and irregularity in stacking includes a use factor.[1]	52 x 42 in., or 15.2 sq. ft.

[1] USE FACTOR.—The additional square feet of floorspace required to provide 6 inches of clearance between lanes of stacked materials, and 2 inches of clearance at each end of the loaded pallet. This additional space allows for irregular stacking of bundles on pallets, and easy in-and-out traffic for each lane with minimum hazard of collision with adjoining stacks.

FIGURE 61.—Stacking pattern and dimensions for palletized full fiber cases of eggs (15 dozen each).

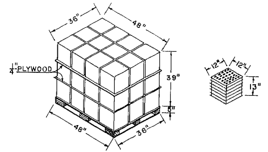


Quantity, weight, and space values:

Number baskets per tier	12.
Number tiers per pallet	5.
Number cases per pallet	30.
Weight baskets and pallet	1,575 lb.
Overall dimensions	50 x 37½ x 75 in.
Space that should be set aside for each pallet to provide clearance between lanes and irregularity in stacking includes a use factor.[1]	54 x 43½ in., or 16.3 sq. ft.

[1] USE FACTOR.—The additional square feet of floorspace required to provide 6 inches of clearance between lanes of stacked materials, and 2 inches of clearance at each end of the loaded pallet. This additional space allows for irregular stacking of bundles on pallots, and easy in-and-out traffic for each lane with minimum hazard of collision with adjoining stacks.

FIGURE 62.—Stacking pattern and dimensions for palletized full wire baskets of eggs (15 cartons each).

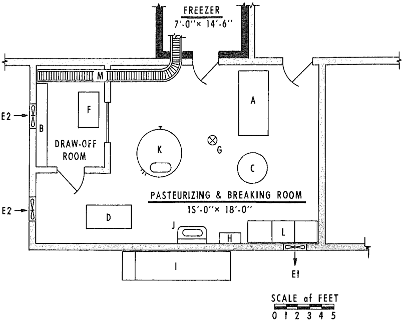


Quantity, weight, and space values:

Number cases (equivalent—30 doz. each) per tier	6.
Number tiers per pallet	3.
Number cases (equivalent—30 doz. each) per pallet	18.
Weight filled flats and pallet	1,070 lb.
Overall dimensions	48 x 36 x 44 in.
Space that should be set aside for each pallet to provide clearance between lanes and irregularity in stacking includes a use factor.[1]	52 x 42 in., or 15.2 sq. ft.

[1] USE FACTOR.—The additional square feet of floorspace required to provide 6 inches of clearance between lanes of stacked materials, and 2 inches of clearance at each end of the loaded pallet. This additional space allows for irregular stacking of bundles on pallets, and easy in-and-out traffic for each lane with minimum hazard of collision with adjoining stacks.

FIGURE 63.—Stacking pattern and dimensions for palletized stacks of full filler flats (15 dozen per stack at two stacks per 30 dozen cases).



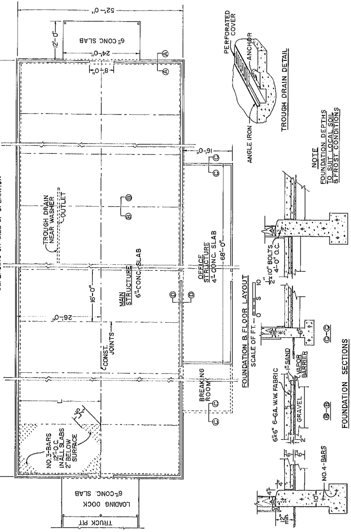
LEGEND

A-BREAKING TABLE (4-Position)
B-CAN RACK
C-CHURN
D-CONTROL CONSOLE
E1-FAN (Exhoust)
E2-FAN (Filtered Air Intoke)
F-FILLING SCALE

G-FLOOR DRAIN
H-HOSE STATION
I-ICE BUILDER
J-LAVATORY
K-PROCESSOR
L-SINK (3-Compartment)
M-ROLLER CONVEYOR

REQUIRES BOILER TO BE LOCATED IN A
CENTRAL SERVICE AREA

FIGURE 64.—Layout for pasteurizing and breaking room suggested by Girton Manufacturing Co.



150' TO 200' DEPENDING ON SIZE OF OPERATION
52'-0"
12'-0"
6" CONC. SLAB
24'-0"
8'-0"
TROUGH DRAIN NEAR WASHER
OUTLET
16'-0"
26'-0"
MAIN STRUCTURE 6" CONC. SLAB
CONST. JOINTS
NO.3-BARS 12" O.C. IN ALL SLABS 2" BELOW SURFACE
LOADING DOCK 6" CONC. SLAB
TRUCK PIT
OFFICE STRUCTURE 4" CONC. SLAB
68'-0"
16'-0"
BREAKING ROOM
FOUNDATION & FLOOR LAYOUT
SCALE OF FT.
PERFORATED COVER
ANCHOR
ANGLE IRON
TROUGH DRAIN DETAIL
NOTE
FOUNDATION DEPTHS TO SUIT LOCAL SOIL & FROST CONDITIONS
2"x10" BOLTS 4'-0" O.C.
6"x6" 6-GA. W.W. FABRIC
1" SAND
VAPOR BARRIER
GRAVEL
NO.4-BARS
FOUNDATION SECTIONS
SCALE OF FT.

Figure 65

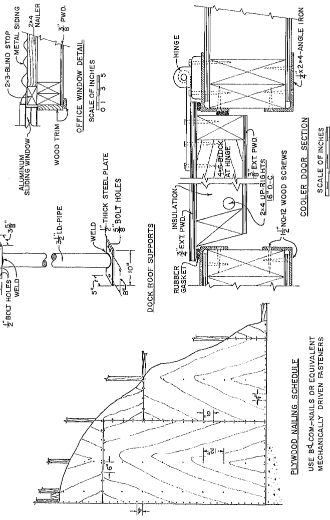
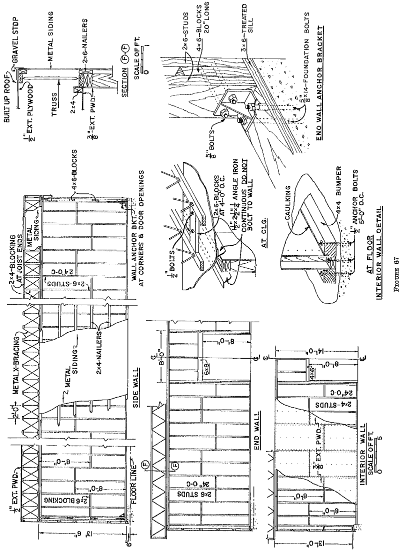

1/4"-THICK STEEL SADDLE
12"
3 5/8"
1/2" BOLT HOLES
WELD
11"
3 1/2" I.D.-PIPE
WELD
1/2"-THICK STEEL PLATE
5/8" BOLT HOLES
10"
5"
8"
DOCK ROOF SUPPORTS
2x3-BLIND STOP
METAL SIDING
2x4 NAILER
3/8" PWD.
ALUMINUM SLIDING WINDOW
WOOD TRIM
OFFICE WINDOW DETAIL
SCALE OF INCHES
0 1 3 5
HINGE
1/4"x2x4-ANGLE IRON
INSULATION
3/4" EXT. PWD.
RUBBER GASKET
4x6-BLOCK AT HINGE
3/8" EXT. PWD.
2x4 UP-RIGHTS 16" O-C
1 1/2" NO-12 WOOD SCREWS
COOLER DOOR SECTION
SCALE OF INCHES
0 1 2 3 4 5
6"
12"
6"
4"
4"
PLYWOOD NAILING SCHEDULE
USE 8d COM.-NAILS OR EQUIVALENT
MECHANICALLY DRIVEN FASTENERS
SCALE OF FT.
0 1 2

FIGURE 66



BUILT UP ROOF
GRAVEL STOP
1/2" EXT. PLYWOOD
METAL SIDING
TRUSS
2×4
2×6-NAILERS
3/8" EXT. PWD.
SECTION F-F
SCALE OF FT.
2×6-STUDS
4×6-BLOCKS 20" LONG
3×6-TREATED SILL
5/8" BOLTS
5/8"×14-FOUNDATION BOLTS
END WALL ANCHOR BRACKET
1/2" EXT. PWD.
METAL X-BRACING
2×4-BLOCKING AT JOIST ENDS
METAL SIDING
2×6 BLOCKING
2×6-STUDS
24"O-C
4×6-BLOCKS
FLOOR LINE
2×4-NAILERS
SIDE WALL
WALL ANCHOR BKT. AT CORNERS & DOOR OPENINGS
1/2" BOLTS
2×6-BLOCKS AT 4'-0" O.C.
1/2"×2 1/2"×1 1/2" ANGLE IRON CONTINUOUS DO NOT BOLT TO WALL
AT CLG.
CAULKING
4×4 BUMPER
1/2" ANCHOR BOLTS 5'-0" O.C.
AT FLOOR
INTERIOR WALL DETAIL
2×6 STUDS 24"O-C
6×8
END WALL
2×4-STUDS
24"O-C
4×6
3/8" EXT. PWD.
INTERIOR WALL
SCALE OF FT.

FIGURE 67

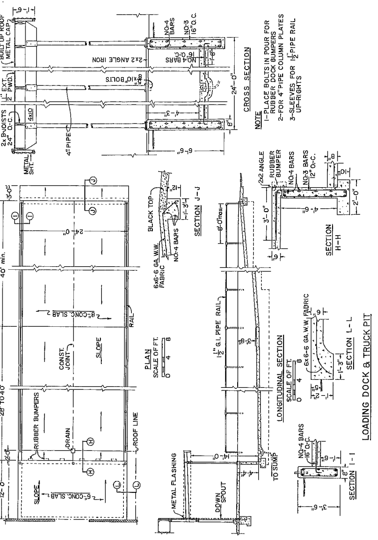

LOADING DOCK & TRUCK PIT
PLAN
SCALE OF FT.
CROSS SECTION
LONGITUDINAL SECTION
SECTION J-J
SECTION H-H
SECTION L-L
SECTION I-I
NOTE
1-PLACE BOLTS IN POUR FOR RUBBER DOCK BUMPERS
2-FOR 4" PIPE COLUMN PLATES
3-SLEEVES FOR 1½" PIPE RAIL UP-RIGHTS
BUILT UP ROOF
METAL CAP
RUBBER BUMPERS
DRAIN
ROOF LINE
CONST. JOINT
SLOPE
RAIL
METAL FLASHING
DOWN SPOUT
TO SUMP
1½" G.I. PIPE RAIL
BLACK TOP
6x6-6 GA. W.W. FABRIC
2x2 ANGLE
RUBBER BUMPER
4" PIPE

FIGURE 68

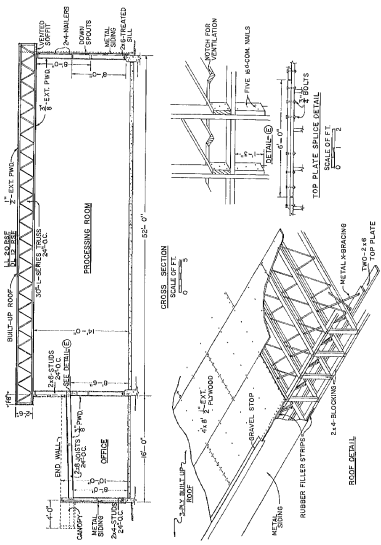
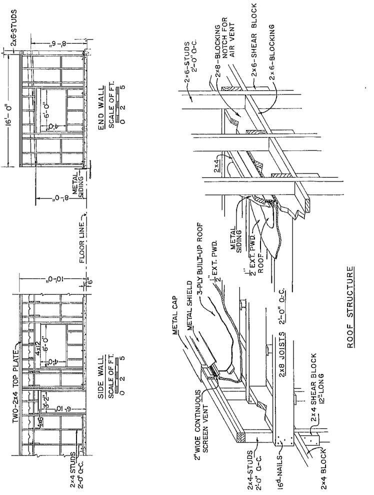

BUILT-UP ROOF
LL 20 PSF
DL 12 PSF
1/2"-EXT. PWD.
30"-L-SERIES TRUSS 24"-O.C.
3/8"-EXT. PWD.
VENTED SOFFIT
2x4-NAILERS
DOWN SPOUTS
METAL SIDING
2x6-TREATED SILL
PROCESSING ROOM
2x6-STUDS 24"-O.C.
SEE DETAIL-E
END WALL
2x8 JOISTS 24"-O.C.
3/8"PWD.
OFFICE
CANOPY
METAL SIDING
2x4-STUDS 24"-O.C.
4'-0"
16'-0"
52'-0"
14'-0"
8'-6"
10'-0"
CROSS SECTION
SCALE OF FT.
NOTCH FOR VENTILATION
FIVE 16d-COM. NAILS
DETAIL-E
6'-0"
3/4" BOLTS
TOP PLATE SPLICE DETAIL
SCALE OF FT.
3-PLY BUILT UP ROOF
4'x 8' 1/2"-EXT. PLYWOOD
GRAVEL STOP
METAL SIDING
RUBBER FILLER STRIPS
2x4-BLOCKING
METAL X-BRACING
TWO-2x6 TOP PLATE
ROOF DETAIL

FIGURE 69



OFFICE STRUCTURAL DETAILS

FIGURE 70

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